

Borehole Logging Procedures

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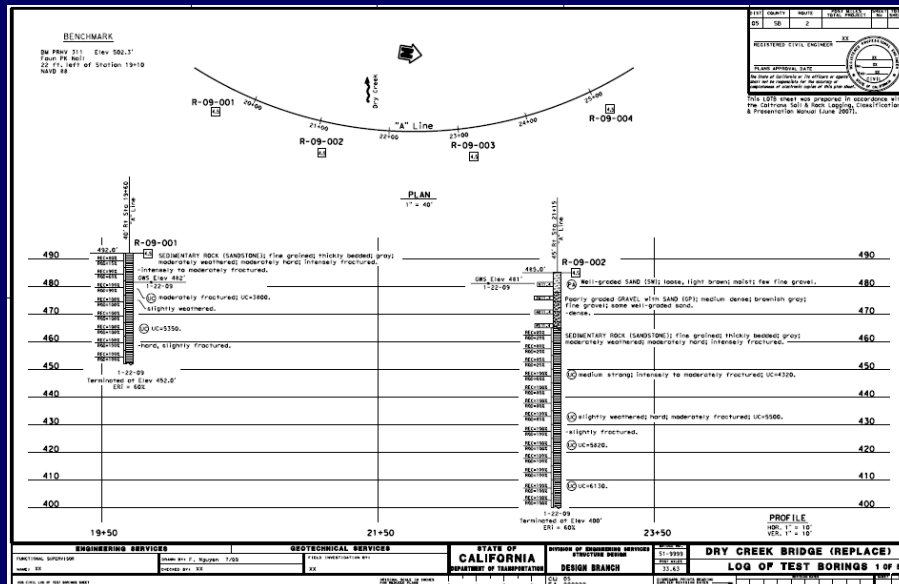
In Review

- Literature search and evaluation of existing information
- Preliminary Reports
- Identified the information required for design and bidding
 - Soil and Rock Locations (vertical and horizontal)
 - Soil Characteristics
 - shear strength, consolidation, liquefaction susceptibility
 - Rock Characteristics
 - Strength, hardness, fracturing
 - Groundwater
- Planned an appropriate investigation to characterize the site
 - Four boreholes, sampling, field testing, lab testing

Borehole Information will be used to:

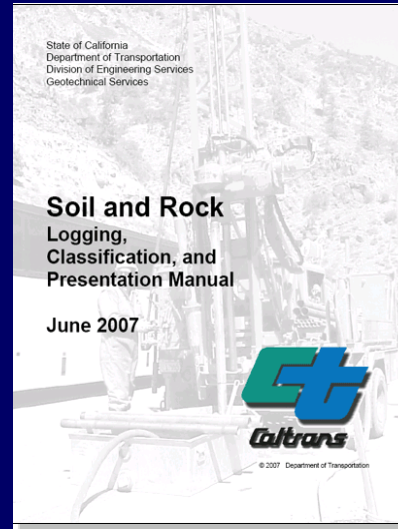
- Select appropriate foundation types
- Perform design calculations
- Make constructability recommendations
- Produce Log of Test Borings (LOTB)
- Provide bidders with a record of known subsurface conditions via the Information Handout

Log of Test Borings



Soil and Rock Logging, Classification, and Presentation Manual

- Department's standard for
 - Logging procedures
 - Reporting terminology
 - LOTB presentation
 - Legends
- Creates a uniform and predictable product for our clients
- Available at:
http://www.dot.ca.gov/hq/esc/geotech/hrequests/logging_manual/logging_manual.html



Sec. 2: Field Identification and Description of Soil

Figure 2-3
Identification and Description Sequence

Sequence	Identification Components	Refer to Section	Required	Optional
1	Group Name	2.4.2	●	
2	Group Symbol	2.4.2	●	
Description Components				
3	Consistency (for cohesive soils)	2.4.3	●	
4	Apparent Density (for cohesionless soils)	2.4.4	●	
5	Color (in moist condition)	2.4.5	●	
6	Moisture	2.4.6	●	
7	Percent of cobbles or boulders	2.4.7	●	
8	Percent or proportion of soils	2.4.8	●	
9	Particle Size Range	2.4.9	●	
10	Particle Angularity	2.4.10		○
11	Particle Shape	2.4.11		○
12	Plasticity (for fine-grained soils)	2.4.12	●	
13	Dry Strength (for fine-grained soils)	2.4.13		○
14	Dilatancy (for fine-grained soils)	2.4.14		○
15	Toughness (for fine-grained soils)	2.4.15		○
16	Structure	2.4.16		○
17	Cementation	2.4.17	●	
18	Description of Cobbles and Boulders	2.4.18	●	
19	Additional Comments	2.4.19		○

- Soil identification is based on ASTM D 2488
- Present identification and descriptors in the sequence shown
- Items marked **REQUIRED** shall be used when applicable

Example presenting required and optional components:

Well-graded SAND with GRAVEL (SW); medium dense; brown and light gray; wet; 75% SAND, coarse to fine, rounded; 20% GRAVEL, coarse, subrounded to rounded, flat and elongated; 5% fines; weak cementation.

Example presenting only required components:

Well-graded SAND with GRAVEL (SW); medium dense; brown and light gray; wet; little coarse GRAVEL; trace fines; weak cementation.

Sec. 2: Field Identification and Description of Rock

Sequence	Identification Components	Refer to Section	Required	Optional
1	Rock Name	2.5.2	●	
	Description Components			
2	Rock Grain-size	2.5.3		○
3	Bedding Spacing	2.5.4	●	
4	Color	2.5.5	●	
5	Texture	2.5.6		○
6	Weathering Descriptors for Intact Rock	2.5.7	●	
7	Rock Hardness	2.5.8	●	
8	Fracture Density	2.5.9	●	
9	Discontinuity Type	2.5.10		○
10	Discontinuity Condition (Weathering, Infilling and Healing)	2.5.11		○
11	Discontinuity Dip Magnitude	2.5.12		○
12	Rate of Slaking (Jar Slake Test)	2.5.13		○
13	Odor	2.5.14		○
14	Additional Comments	2.5.15		○

- Based on the International Society of Rock Mechanics and the USBR Engineering Geology Field Manual

Rock Example:

IGNEOUS ROCK (GRANITE); light gray and light yellowish brown; intensely weathered; soft; unfractured

Core Recovery:

$$REC = \frac{\Sigma (\text{Length of the recovered core pieces, inches})(100\%)}{\text{Total length of the core run, inches}}$$

Rock Quality Index:

$$RQD = \frac{\Sigma (\text{Length of intact core pieces} \geq 4 \text{ inches})(100\%)}{\text{Total length of the core run, inches}}$$

Section 3: Laboratory Testing

- Optional – not required for many designs
- Laboratory testing may be used to revise/refine the following:
 - Soil
 - Group Name
 - Group Symbol
 - Percent or Proportion of Soils
 - Particle Size Range
 - Consistency
 - Plasticity
 - Rock Strength

Section 4: Methods of Presentation of Subsurface Data

- Revising/Combining sample observations and creating layers.

Section 5: Boring Log and Legend Presentation Formats

- Presents the formats for:
 - Log of Test Borings (LOTB)
 - Boring Records (BR)
 - Legends

Group Exercise

- Build a descriptive sequence for the sample provided
 - Group Name
 - Group Symbol
 - Apparent Density ($N = 16$) ($ER_i = 75\%$)
 - Color
 - Moisture
 - Percent or Proportion of Soils
 - Particle Size Range

Some Help

- Estimate the % (by weight) of
 - Gravel (Coarse and Fine)
 - Sand (Coarse, Medium, Fine)
 - Fines (Silt and Clay)
- Navigate the Table to select a Group Name and Group Symbol
 - Well-graded vs. Poorly-graded
- Calculate N_{60} then select an Apparent Density
- Use “Proportion” terms to describe amount of Gravel, Sand, and fines in order of their abundance.

More Help

$$N_{60} = N * (ER_i / 60)$$

$$N_{60} = 16 * 75/60 = 20 \rightarrow \text{Medium Dense}$$

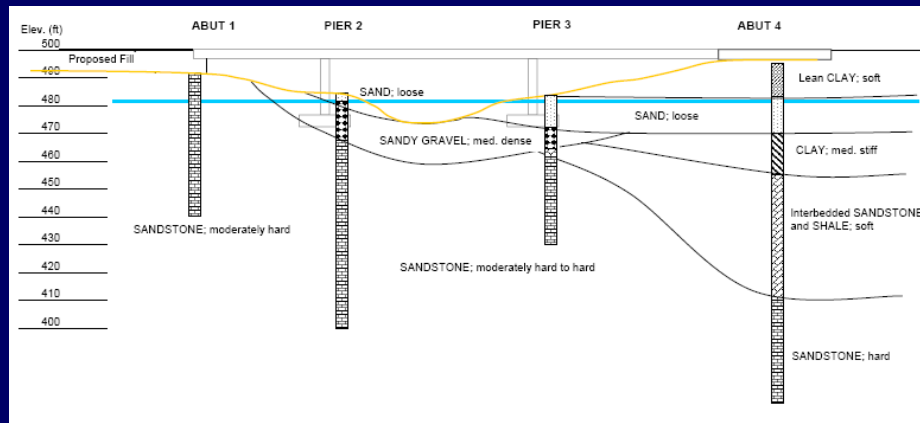
Group Exercise Answers

1. Well-graded SAND with GRAVEL (SW); medium dense; light brown and gray; little fine GRAVEL; trace fines
2. Well-graded GRAVEL with CLAY (GW-GC); medium dense; light brown and gray; dry; few medium SAND
3. Well-graded GRAVEL (GW); medium dense; light brown and gray; dry; some well-graded SAND
4. Poorly-graded SAND with GRAVEL (SP); medium dense; light brown; dry; medium SAND; some well-graded GRAVEL; trace fines
5. Clayey SAND (SC); medium dense; brownish gray; dry; well-graded SAND; some fines, high plasticity; trace fine GRAVEL

Dry Creek Bridge Update

- Logged four holes
- Performed field testing (SPT, Pocket Pen, Torvane)
- Collected samples for Laboratory Testing
 - Unconfined Compression (Qu) on Rock
 - Particle Size analysis (PA) on Sand
 - Plasticity Index (PI), Triaxial (UU), and Consolidation on Soft Clay
 - Corrosion on Sand and Clay
- Produce field log sheets and a draft geologic profile

Draft Geologic Profile



Questions?